

Experiment Notes – Deformation Dilatometer Trials on Recyclable-Friendly Aluminium Alloys

Homogenisation 1 – 590°C for 8 hours.

	560°C	520°C	490°C
0.1 s ⁻¹	009 – 2 TCs but odd temperature difference shown 016 – 2 TCs	006 – 1 TC	007 – 1 TC 017 – 2 TCs
1.0 s ⁻¹	010 – 2 TCs	004 – 2 TCs, but no Mo discs used 005 – TC2 broke off and TC1 broke during He gas cool, so sample remained hotter for longer 018 – 1 TC	008 – 1 TC 019 – 2 TCs
10.0 s ⁻¹	014 – 2 TCs 015 – 2 TCs	013 – 2 TCs	011 – TC2 didn't work. Heat off applied during deformation, but sample temp dropped by over 100°C 012 – 2 TCs

001 – Silica glass rods used with Mo discs and Alumina platens. Showed nearly no temp difference. Thermocouple (TC) broke during test and silica glass rods broke too.

002 – Repeat of 001 with Al₂O₃ transmission rods which seems to work better and these rods don't shatter during deformation.

004 – Applied 3 mins of He gas cooling at the end, which used up too much gas. Change applied He gas cooling to 10 seconds. Spike in load appears during cooling, but there is no plastic deformation of sample. Assume spike in load is because there is no high temperature hold of 5 secs. Sample fused to platens as Mo discs weren't used. Will use Mo discs from now on. Note, on this test the heating shows less fluctuations at low temperature without the Mo discs, possibly due to better contact with platens.

005 – TC2 broke on cooling, then TC1 broke on the He gas cooling, so sample remained hotter for longer during the cooling as the machine switched off. Greater temperature fluctuations during heating, possibly caused by glue or Mo discs, but this can't be helped.

006 – No second TC due to problems with spot welding. More He gas cooling needed to cool sample. Increase sample cooling to 20 seconds of gas cooling + 5 secs of He gas during quench. For high temp tests at 560C increase cooling to 30 seconds + 5 secs of He gas during quench.

007 – No TC2 as broke when loading sample and couldn't be fixed.

008 – TC2 broke as loading sample again. Best way to load sample is to hold wires of thermocouple close to sample, click in the ends of the thermocouple, then rotate sample into the holder. Then move thermocouples into induction coil without trying to bend wires too much.

009 – Sample was cooled down from 540C with power off to check the thermocouples 1 and 2 were connected properly. Then sample was reheated back to 540C. Unusually TC2 was recording hotter than the centre here.

010 – Good.

011 – Heat up to 540C then thermocouple broke, so sample cooled with power off. Fixed TC and reran test. Cooling off applied during high temp. deformation, but sample showed over 100C cooling during deformation here. Will apply heating on during high temperature deformation for all tests (including 10 /s). Also, TC2 doesn't seem to be working as temp difference is too high.

012 – TC2 working better and heat applied during deformation.

013 – Good.

014 – Good.

015 – Good.

016 – Good.

017 – Good.

018 – TC2 broke as loading sample so ran without TC2.

019 – Sample not machined well at the end (some rough surface). See pictures.

Homogenisation 2 – 520°C for 2 hours.

	560°C	520°C	490°C
0.1 s ⁻¹	022 – 2 TCs 033 – 2 TCs	021 – 2 TCs 037 – 2 TCs, but sample pre-heated and cooled before test	020 – 2 TCs 032 – 1 TC
1.0 s ⁻¹	025 – 1 TC 038 – 2 TCs	024 – 2 TCs 034 – 2 TCs but noisy thermocouple reading with fluctuations. But, deformation seems fine.	023 – 1 TC 035 – 2 TCs
10.0 s ⁻¹	029 – 2 TCs, some temp. fluctuations but deformation doesn't seem affected. 030 – 1 TC	026 – 1 TC 036 – Noisy thermocouple again, but deformation not affected.	027 – 2 TCs. Noisy thermocouple again, but deformation not affected. 031 – 2 TCs

020 – Good.

021 – Good. Mislabelled as Hom 1 when running test. This was then changed later, so have two copies of the data, incorrectly labelled Hom 1 and correctly labelled Hom 2.

022 – Good.

023 – TC2 missing, fell off too many times to be spot-welded back on.

024 – Good.

025 – TC2 missing as fell off too many times to replace.

027 – Issue with temperature oscillations during high temp. hold. But, the temp. control seems fine during the high temp. deformation stage, so results should still be valid.

028 – Thermocouple broke during deformation and data stopped recording half way through.

029 – Some temp. fluctuations prior to the deformation stage.

030 – Thermocouple 2 broke during deformation, but then reattached. Assume temp. recordings for TC2 are still inaccurate though.

031 – Good.

032 – Only 1 TC due to issues with spot-welding.

033 – Only 25s of gas during cooling rather than 30s for cooling from 560C seems enough and will save the He gas.

034 – Temp control a bit noisy due to fluctuations, but allow test to run anyway as high temp. deformation seems ok.

035 – Good.

036 – Noisy TC again, will stop using this thermocouple from now on, could be a bad connection. Data still seems valid though.

037 – TC broke on heating, didn't reach 540C, only reached 400C. Reran tests with new thermocouple.

038 – Good.